What is claimed is:

1. A method of making nanoscale catalyst patterns comprising;

i) providing a malleable membrane having a top surface;

ii) providing a mold having one or more nanoscale protrusions;

iii) pressing the protrusions into the membrane to form one or more nanoscale recesses in the membrane, each recess having a bottom and side walls between the top surface of the membrane and the bottom of the recess; and

iv) depositing a layer of catalytic material on the top surface of the membrane and the bottom of the recesses.

2. The method of claim 1, said membrane comprising a polymer.

3. The method of claim 1, wherein said membrane is an ion conductive membrane.

4. The method of claim 1, wherein said membrane is a polymer electrolyte membrane.

5. The method of claim 1, said membrane comprising a perfluorosulfonic acid polymer electrolyte.

6. The method of claim 1, said mold comprising a substrate; and a molding layer including an array of protruding features having nanoscale dimensions.

7. The method of claim 1, said nanoscale protrusions having a lateral dimension of about one nanometer to about 100 micrometers.

8. The method of claim 1, said nanoscale protrusion having a height of about one nanometer to about 100 micrometers.

9. The method of claim 1, said nanoscale protrusions having the shape of a pillar.

10. The method of claim 1, said nanoscale protrusions forming a regular pattern.

11. The method of claim 1, said nanoscale recesses being the obverse shape of the protrusions.

12. The method of claim 1, wherein the bottom of the recess is parallel to the top surface of the membrane.

13. The method of claim 1, wherein the side walls of the recess is perpendicular to the bottom of the recess and the surface of the membrane.

14. The method of claim 1, the side walls of the recesses having a depth of about one nanometer to about 100 micrometers.

15. The method of claim 1, wherein the side walls remain substantially free of catalytic material.

16. The method of claim 1, wherein said catalytic material is also an electrode.

17. The method of claim 1, wherein said catalytic material comprises a metal.

18. The method of claim 17, wherein the metal is platinum.

19. A membrane electrode assembly comprising:

i) an ion conductive membrane having a top surface and one or more nanoscale recesses, each recess having a bottom and side walls between the top surface of the membrane and the bottom of the recess; and

ii) a catalytic electrode layer coating the top surface of the membrane and the bottom the recess.

20. The membrane electrode assembly of claim 19, said ion conductive membrane comprising a cation or proton-transporting polymeric electrolyte material.

21. The membrane electrode assembly of claim 19, said ion conductive membrane comprising salts of polymers containing anionic groups.

22. The membrane electrode assembly of claim 19, said recess having the shape of a nanohole.

23. The membrane electrode assembly of claim 19, said recesses having a lateral dimension of about one nanometer to about 100 micrometers.

24. The membrane electrode assembly of claim 19, said recesses forming a regular pattern.

25. The membrane electrode assembly of claim 19, wherein said side walls are essentially free of catalytic electrode material.

26. The membrane electrode assembly of claim 19, said catalytic electrode layer comprising a metal.

27. The membrane electrode assembly of claim 26, wherein said metal is platinum.

28. An electrochemical device comprising:

i) a solid electrolyte; comprising an ion conductive membrane imprinted with a plurality of nanoscale features;

ii) a first catalytic electrode adjoining one portion of the membrane;

iii) a second catalytic electrode adjoining another portion of the membrane; and

iv) a circuit connecting the first and second electrodes.

29. A fuel cell comprising:

i) the electrochemical device of claim 28; and

ii) reactants capable of undergoing an oxidation reduction at the catalytic electrodes.

30. The fuel cell of claim 29, wherein the reactants comprise fuel and an oxidant.

31. The fuel cell of claim 30, wherein the fuel is hydrogen and the oxidant is oxygen.

32. A method for preparing a mold for use in nanoimprinting, comprising:

i) providing a mold having a top surface;

ii) overlaying one or more nanoscale masking elements on the top surface of the mold; and

iii) etching portions of the mold left unprotected by the masking elements to form protruding features in the mold; and

iv) removing the masking elements on top of the protruding features.

33. A mold for nanoimprinting, comprising:

i) a substrate; and

ii) a molding layer comprising one or more protruding features having nanoscale dimensions.